Health Education “Hokenshido” Program Reduced Metabolic Syndrome in the Amagasaki Visceral Fat Study. Three-Year Follow-up Study of 3,174 Japanese Employees

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Abstract

Objective The aim of this study was to evaluate the effects of health checkup and the health education “Hokenshido” program based on the concept that visceral fat accumulation causes metabolic syndrome (MetS), leading to cardiovascular disease (CVD).

Methods and Subjects Based on the Japanese definition of metabolic syndrome, in the annual health checkup for general subjects, the measurement of waist circumference and use of “Where am I?” chart on the way to develop atherosclerosis were introduced. The study group comprised 3,174 Japanese employees [2,440 males (46±11 years, mean ± SD), 734 females (43±10 years)], who underwent annual health checkup in 2003, 2004, and 2005. The medical staff provided “Hokenshido” for subjects assessed as having MetS and/or at high risk for CVD.

Results The prevalence of the MetS in 2003, 2004 and 2005 decreased in males (20.8%, 17.2%, 14.4%, $p<0.001$) and females (3.0%, 2.2%, 1.9%, $p=0.359$), respectively. Among subjects with MetS at baseline, the number of subjects with MetS significantly decreased in males (508, 287, 247, $p<0.0001$) and females (22, 8, 6, $p<0.0001$), respectively. Mean waist loss was 1.6 cm in males (<0.0001) and 1.5 cm in females (<0.001). Among subjects with metabolic syndrome at baseline, the mean waist loss was 2.5 cm in males (<0.0001) and 3.9 cm in females (<0.05). Fatal atherosclerotic vascular events were not recorded in this study period.

Conclusion Health check-up and the “Hokenshido” program reduced the prevalence of the MetS, which might lead to prevention of CVD.

Key words: metabolic syndrome, health checkup, health guidance, Hokenshido, visceral fat accumulation, cardiovascular disease

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Introduction

The metabolic syndrome is a risk factor for atherosclerotic cardiovascular diseases (CVD) (1). Visceral fat accumulation caused by overnutrition and physical inactivity is

closely related to glucose intolerance, dyslipidemia, hypertension, and CVD (2-4). Once a diagnosis of the metabolic syndrome is established, management of the condition, lifestyle change as the primary intervention and assessment of cardiovascular risk factors should be adequately conducted to reduce the risk of CVD (5-7).

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Table 1. Clinical Characteristics of the Subjects at Baseline

Variables	Male (n=2440)	Female (n=734)
Age, years	45.5±10.6	43.0±9.7
Body weight, kg	69.4±9.8	54.6±8.5
Body mass index, kg/m ²	24.3±3.1	22.3±3.5
Waist circumference, cm	84.9±8.3	78.2±10.0
Triglyceride, mg/dL	174.1±123.1	105.3±75.1
HDL cholesterol, mg/dL	53.7±14.7	65.4±15.4
LDL cholesterol, mg/dL	115.4±29.7	111.7±28.7
Systolic blood pressure, mm Hg	130.3±15.7	119.2±15.6
Diastolic blood pressure, mm Hg	80.1±11.8	71.9±11.9
Plasma glucose, mg/dL	105.3±33.4	98.3±24.7

Data are means±SD. HDL, high-density lipoprotein; LDL, low-density lipoprotein.

In Amagasaki City Office, 7 fatal atherosclerotic vascular events were recorded from year 1995 to 2002 in all 4,000 employees. In addition to the health costs, the insurance costs had also been increasing. Therefore, prevention of CVD was an important and urgent task for the city and employer. To this end, measurement of waist circumference in annual health checkup commenced in year 2003 in these employees, based on the concept that visceral fat accumulation causes the metabolic syndrome. According to the results of the health checkup, a health education “Hokenshido” program, using “Where am I?” chart on the way to develop atherosclerosis, was applied by the medical staff to prevent further development of lifestyle-related diseases and CVD for each subject. We reported previously that the decrease in visceral fat within one year correlated with the decrease in the number of metabolic risk factors (raised blood pressure, dyslipidemia and glucose intolerance) and increase in serum levels of adiponectin (8-17).

The aim of this study was to evaluate the effect of this whole program on the incidence of metabolic syndrome for each year and for each generation of males and females.

Materials and Methods

Participants

This urban area study group comprised 3,174 Japanese [2,440 males (45.9±10.6 years, mean ± SD), 734 females (43.0±9.7 years)] who were employees of the Amagasaki City Office, Hyogo, Japan and had completed the Government-funded annual health checkup every year from 2003 to 2005. The clinical characteristics of the study participants at baseline in year 2003 are shown in Table 1. Of the entire group, 118 (3.7%), 337 (10.6%), and 115 (3.6%) individuals were under treatment for dyslipidemia, hypertension, or diabetes, respectively, at baseline.

All participants gave full informed consent to participate in the study and ethical approval was obtained from committee on the Ethics of Human Research of Osaka University. This trial is registered with number UMIN 000002391 (the Amagasaki Visceral Fat Study).

Anthropometry and laboratory measurements

Height and weight were measured in the standing position. Body mass index was calculated as weight (kg) divided by the square of height in meters (m²). Waist circumference at the umbilical level was measured in cm with a non-stretchable tape in the late exhalation phase at standing position (18). Systolic and diastolic blood pressure values were measured in the sitting position. Blood was withdrawn fasting or postprandial condition. Biochemical variables were measured with a conventional automated analyzer.

Assessment of risk factors

We defined the metabolic syndrome according to the guidelines for the diagnosis in Japan (19). Abdominal obesity, waist circumference equal to or greater than 85 cm in men or greater than 90 cm in women plus the presence of at least two of the following abnormalities: 1) dyslipidemia; a serum fast triglyceride level over 150 mg/dL and/or a serum high-density lipoprotein (HDL) cholesterol level less than 40 mg/dL, 2) hypertension; systolic blood pressure over 130 mmHg and/or diastolic blood pressure over 85 mmHg and 3) high glucose; serum fast glucose level over 110 mg/dL. Subjects who received specific treatment(s) for each of the above metabolic risk factors were considered positive for that factor. It means that, those who had a risk factor without treatment and those who were on treatment were also included as study subjects. In the case that blood samples were not obtained after >8-hour fasting, we modified 1) to 1)' dyslipidemia; postprandial triglyceride level over 200 mg/dL (20, 21) and/or a serum high-density lipoprotein (HDL) cholesterol level less than 40 mg/dL, 3) to 3)' as high glucose; postprandial serum glucose level over 140 mg/dL (22).

Detailed examination

Oral glucose tolerance test, bicycle ergometer stress test, and carotid artery echography were performed in those subjects with risk factor(s) based on the recommendation of the team physician.

Figure 1. The “Where am I?” chart. All results were transferred into this chart for the individual subject. The metabolic risk factors of vascular damage were displayed at the bottom part of the chart. The results of detailed examination to estimate the current condition of vascular damage were set at the middle of the chart. The status of presence or absence of diseases such as cardiovascular diseases (CVD) was displayed at the top of the chart. BMI: body mass index, WC: waist circumference, VFA: visceral fat area, LDL.C: low-density lipoprotein cholesterol, TG: triglyceride, HDL.C: high-density lipoprotein cholesterol, PG: plasma glucose, OGTT: oral glucose tolerance test, Cr: serum creatinine, eGFR: estimated glomerular filtration rate, PWV: pulse wave velocity, ABI: ankle-brachial index, IMT: intima media thickness

Health guidance (“Hokenshido”)

After the health checkup, all of the participants receive the results of the health checkup and “Where am I?” chart (Fig. 1). To enhance understanding, all of the subjects were informed and given the opportunity to attend lectures by public health nurses and medical doctors.

In “Where am I?” chart, the metabolic risk factors of vascular damage were displayed at the bottom part of the chart. The results of detailed examination to estimate the current condition of vascular damage were put at the middle (of the chart). The status of presence or absence of diseases such as CVD was displayed at the top (of the chart). The placement of visceral fat accumulation at the bottom (part) implicates that metabolic risk factors, such as dyslipidemia, hyperglycemia, hypertension, and hyperuricemia are “the tip of the iceberg”, and that visceral fat accumulation (dysregulation of adipocytokines in abdominal and visceral obesity) should induce the development of the risk factors, leading to atherosclerotic CVD and chronic kidney disease. Through this chart stream, the subjects having visceral fat accumulation can imagine their assumable stage for vascular damage, and

be encouraged to alter their problematic lifestyle toward reducing visceral fat and cardiovascular risks. Such subjects are spontaneously helped to identify themselves as high risk subjects using this chart, based on the presence of multiple risk factors with visceral fat accumulation. On these conditions, health education “Hokenshido” program was provided by group and/or individual counseling. Public health nurse and dietitian interviewed and counseled the subjects about their pattern of meal, intake of alcohol, and habit of exercise. Through these processes, the guided subjects could determine the problematic habits which should be altered.

The number of subjects who received individual “Hokenshido” were 429 (13.5%) in year 2003, and 123 (3.9%) in year 2004. In particular, the subjects who could not improve their habit in the initial term were encouraged to repeatedly receive the group and individual lecture. The subjects considered already at high risk for CVD and chronic kidney diseases were referred to consult a cardiologist, neurologist, or nephrologist. Such subjects were continuously on the program to enhance the alteration of their problematic habits.

Figure 2. Age-related prevalence of the metabolic syndrome from year 2003 to year 2005. Male (n=2,440), female (n=734). Kruskal Wallis test with a Scheffe's test.

Table 2. Change in Waist Circumferences

			Waist circumference, cm			p
			year 2003	year 2004	year 2005	
Male	All	2440	84.9 ± 8.3	84.1 ± 8.4	83.3 ± 8.3	< 0.0001
	'03MS (+)	508	92.8 ± 6.7	91.5 ± 7.6	90.3 ± 7.4	< 0.0001
	'03MS (-)	1932	82.8 ± 7.4	82.1 ± 7.5	81.5 ± 7.5	< 0.0001
Female	All	734	78.2 ± 10.0	76.2 ± 9.4	76.7 ± 9.8	< 0.001
	'03MS (+)	22	98.3 ± 5.5	93.5 ± 6.6	94.4 ± 6.8	< 0.05
	'03MS (-)	712	77.6 ± 9.4	75.7 ± 9.0	76.2 ± 9.3	< 0.001

Data are means±SD.

'03MS (+), with the metabolic syndrome at baseline; '03MS (-), without the metabolic syndrome at baseline.

Kruskal-Wallis test with a Scheffe's test

Statistical analysis

The comparison of prevalence of the metabolic syndrome and risk factors in the 3 year period were analyzed by Kruskal Wallis test with a Scheffe's test. The statistical significance of the differences in the waist circumferences in 3 years were also analyzed by Kruskal Wallis test with a Scheffe's test. All statistical analyses were performed with StatView-J 5.0 (SAS Inc.).

Results

Age-related prevalence of the metabolic syndrome increased from the age of 30 years and was the highest in the 50-59 year age group in males and increased after the age of 50 years in females (Fig. 2). After initiating measurement of waist circumference in annual health checkup, use of "Where am I?" chart, and "Hokenshido", the prevalence decreased among males aged 30-39 years, 40-49 years, and 50-59 years ($p<0.01$), and among females aged 50-59 years, and 60-69 years during the 3-year period of this study.

The prevalence of the metabolic syndrome in 2003, 2004

and 2005 decreased in males (20.8%, 17.2%, 14.4%, $p<0.001$) and females (3.0%, 2.2%, 1.9%, $p=0.359$). Decreased prevalence of the metabolic syndrome in males was associated with significant reductions in the prevalence of abdominal obesity, dyslipidemia, and hypertension ($p<0.0001$). Among subjects with metabolic syndrome at baseline, the number of subjects with metabolic syndrome significantly decreased in males (508, 287, 247, $p<0.0001$) and females (22, 8, 6, $p<0.0001$), respectively.

Significant reductions of waist circumference were seen in males and females (Table 2). Mean waist loss was 1.6 cm in males ($p<0.0001$) and 1.5 cm in females ($p<0.001$). Among subjects with metabolic syndrome at baseline, the mean waist loss was 2.5 cm in males ($p<0.0001$) and 3.9 cm in females ($p<0.05$).

To be noted, during the 3-year period of this study, no fatal atherosclerotic vascular events were recorded.

Discussion

In the present study, we demonstrated that 1) after initiating measurement of waist circumference in annual health

checkup, use of “Where am I?” chart, and “Hokenshido” the prevalence of metabolic syndrome decreased with reductions in risk factors in males and females, 2) significant reductions of waist circumference were seen in males and females, 3) especially among males and females with the metabolic syndrome at baseline, the respective prevalence decreased markedly, and 4) fatal atherosclerotic vascular events were not recorded during the 3-year study period.

Based on the National Nutrition Survey in Japan, the rate of male obesity has been increasing. In this sense, the national campaign to improve the health of all Japanese people, called Kenko (Health) 21st, has not been fully successful. In the current study and program for the city employees, measurement of waist circumference and understanding of “Where am I?” chart seemed to be quite helpful to perceive their health conditions and reconsider the problematic habit. Through “Hokenshido”, the guided subjects recognized a problem in their own lifestyle and attempted to reduce visceral fat as a goal to maintain a healthy life. In our Amagasaki Visceral Fat Study (8-17), we reported that the decrease in visceral fat was correlated with the decrease in the number of metabolic risk factors in the general male population (8).

Regarding the lack of fatal CVD events during the three-year study period, improvements of risk factors and possibly also the improvements of adipocytokine dysregulation such as hypoadiponectinemia might stabilize arterial plaque.

A limitation of this study is that majority of blood samples were nonfasting. To enhance annual health checkup for as many employees, such blood sampling policy, either fasting or nonfasting, is allowed by the employer in many work places in Japan. Data were evaluated according to the criteria described in Materials and Methods, dependent on individual fasting or non-fasting conditions. Furthermore subjects with one or two risks without obesity should be also followed-up closely. In this study, 180 (5.7%), 446 (14.1%), and 162 (5.1%) individuals were under treatment for dyslipidemia, hypertension, or diabetes, respectively, in year 2005.

Collectively, regular health checkups and “Hokenshido” program, which is based on the concept that visceral fat accumulation causes metabolic syndrome, effectively reduced the prevalence of the metabolic syndrome and various risk factors, which might lead to the prevention of CVD.

The authors state that they have no Conflict of Interest (COI).

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